# OBTAINING PLANT MATERIALS FOR BIOTECHNICAL WORK

**John A. Dickerson**

**Plant Materials Specialist**
**USDA- Natural Resource Conservation Service**
**Syracuse, NY**

**Theodore L. Kelsey**

**Resource Specialist**
**USDA-Natural Resource Conservation Service**
**Durham, NH**

**Christopher R. Jones**

**Conservation Agronomist**
**USDA- Natural Resource Conservation Service**
**Bangor, Maine**

**Donald W. Lake, Jr.**

**State Conservation Engineer**
**USDA- Natural Resource Conservation Service**
**Syracuse, NY**

**Raymond G. Godfrey**

**Resource Conservationist**
**USDA- Natural Resource Conservation Service**
**Winooski, VT**

## ABSTRACT

**The U.S. Department of Agriculture Natural Resource Conservation Service (NRCS) utilized biotechnical slope stabilization (BSS) systems along the Winooski River, Vermont, in the 1940's. Though successful in that application, interest lagged until recently. Now economics and aesthetics are driving a resurgence of interest in BSS. Textbook approaches to BSS recommend using willow materials harvested from native stands on or near the site as planning stock. An alternative approach is to use known materials, such as tested and release NRCS cultivars from managed production areas. A series of plantings was initiated in 1987 to**

**establish the manpower and time requirements necessary to cultivate, harvest, and prepare "Streamco" and "Bankers" willow for BSS plantings. Also, the success and response of these cultivars has been monitored in four states under a variety of soil and site conditions. The success demonstrates the efficacy of the cultivars and the modified procedures.**

## INTRODUCTION

Plant materials for biotechnical slope stabilization may be obtained in two basic ways. One method noted by Gray and Leiser is to locate stands of appropriate species and obtain permission to cut materials from these stands.[1] Sotir and Gray, and Gray and Leiser, discussed the selection of suitable plant materials for making wattles. [1,2] Their criteria were: (1) easy rooting, (2) long, straight, and flexible whips, and (3) in plentiful supply near the job site. A second method, not generally discussed in the literature, is to grow and harvest materials from managed production beds. The purpose of this paper is to explor the merits of obtaining materials from nurseries compared to the use of wild stands.

The implied advantages of the "job-site collection" method are low production cost, low transportation cost, and local adaptation. Low transportation cost is provided by proximity to the end use site. The author questions the validity of the low cost assumption and the faith in local plant performance. There are costs (sometimes hidden) associated with finding stands of suitable materials, obtaining permission to harvest, and especially with the harvest operation.

Willows are highly recommended by Gray and Leiser for biotechnical work.[1] Edminster, Atkinson, and McIntyre rated purpleosier willow as an outstanding plant when utilized as cuttings or poles along the Winooski River in Vermont.[5] Purpleosier willow was better able to resist ice damage due to its resiliency than were other species. Growth was rapid, averaging eight to nine feet after five years.

Redosier dogwood was also used by Edminster, Atkinson, and McIntyre on the Winooski River.[5] It was the only other shrub species used, and was planted as seedings rather than cuttings. The plants averaged five feet in height after eight years when planted low on the river bank. Attributes cited were greater stem flexibility than purpleosier willow and good recovery from mechanical damage through sprouting and branch layering.

Suitable species for biotechnical slope protection exist throughout the northeast states. Stands of willow, both native and introduced species, can be found in most locales. Dogwoods are also common. However, is a given stand made up of plants which are in the upper or lower end of the scale for rooting ability within the species? That such a question should be asked was illustrated by testing of redosier dogwood (Comus stolonifera) collections from New York and surrounding states at the Natural Resource Conservation Service Big Flats Materials Center. Collections differed widely in their individual ability to root where branches contacted the ground. The root mass generated by one clone led to its release as the cultivar, "Ruby." The history of plant selection and improvement was generated by the wide differences within, as well as between species.

Also worthy of question is the assumption that a given local willow, which is growing well on site A, will also

grow well on site B. Site B may have a different soil and moisture regime or a markedly different microclimate. Is there any way of knowing how the willow from site A will perform at site B? The range of conditions that selected and tested plants must tolerate during their development is normally very wide, particularly for conservation plants. So there is a history of performance which justifies the release and preferred use of the tested plants. The risk of poor performance from untested plants may lead to the ultimate cost-failure.

Locally obtained plant materials are attractive because they will obviously save transportation cost. However, the access problems, liability problems, and working conditions at the site may make the transportation benefit less attractive. Production nurseries, on the other hand, are located on level ground, usually having buildings for material handling nearby, and are equipped for efficient operation. Liability is not a problem. In the Northeast materials for planting in the March to May period are often prepared during stressful weather conditions. Nurseries provide the best environment to minimize the risk of accidents and employee stress, while maximizing labor efficiency.

Preparation of materials is likely to be easier, and faster from production beds than from native stands. When native stands are raided the better materials must be cut from the existing growth. Double cutting is often required and the branches are difficult to compress into wattles. Stooling beds in nurseries will produce uniform young, straight, long unbranched stems, which are easily cut and bundled. The material thus prepared can be monitored for insect and disease problems. Plant materials obtained from properly managed nursery production beds have the advantage of known history and adaptation, ease of preparation, and higher quality. Native stands can proximity to the job site as their prime advantage.

**MATERIALS AND METHODS**

To evaluate selected willows and dogwood that are already in the nursery trade, a series of plantings were made with nursery prepared materials over a three-year period in four Northeastern states.

The plant materials for the trials were prepared at the U.S. Department of Agriculture, Natural Resource Conservation Service, Big Flats, New York, and Quicksand, Kentucky, Plants Materials Centers. Cutting blocks of willow and dogwood are maintained for producing materials to distribute to commercial growers. Appropriate cultural practices result in unbranched stem growth five to seven feet tall. These branches (or whips) were harvested in late February prior to bud-swell and held dormant in controlled storage. This system provided fresh, vigorous new growth for use. For comparison, wattles were also prepared with older stems. The harvested whips were tied into wattles that were four to six inches in diameter.

The plant materials used were “Streamco” purple-osier willow (Salix purpurea L.), “Bankers” dwarf weillow (Salix X cottetii Kerner), and “Ruby” redosier dogwood (Cornus stolonifera Michx). Table 1 is a comparative summary of cultivar data.

**Table 1. Cultivars Used in Slope Stabilization Plantings.**

| Cultivar | Species | Location of Development | Year[1] Released | Hardness Zones [2] | Mature [3] Height (ft) |
|---|---|---|---|---|---|
| Streamco | purpleoiser Willow | Big Flats, NY | 1976 | 3-8 | 15-20 |
| Bankers | dwarf willow | Quicksand, NY | 1983 | 4-8 | 6-7 |
| Ruby | redosier Dogwood | Big Flats, NY | 1989 | 3-8 | 6-8 |

1 Released to commercial nurseries by the Natural Resource Conservation Service
2 USDA Misc. Publication 814.
3 When grown as solitary plants.

**Table 2. Materials Used and Soil Texture by Planting Site.**

| Site | Date | Wattles Streamco | Wattles Bankers | Wattles Ruby | Soil Texture |
|---|---|---|---|---|---|
| Cornwallville, NY | June 1987 | 40 | 0 | 0 | silty clay |
| Gowanda, NY | May 1988 | 248 | 108 | 12 | silt loam |
| Gaysville, VT | Nov. 1988 | 65 | 0 | 0 | v. sandy loam |
| Raymond, NH | Mar 1989 | 125 | 30 | 0 | sand |
| Bangor, ME | May 1989 | 50 | 0 | 0 | silt loam & clay |
| New Castle, ME | May 1989 | 95 | 20 | 0 | sand |
| Houlton, ME | May 1989 | `40 | 15 | 0 | gravelly sand |

**Table 3. Approximate Preparation Time for "Streamco" Willow Wattles.**

| Methods | Material Age (Yr.) | Production Per Person Per Hour |
|---|---|---|
| Hand cut | 1 | 12 |
| Chain saw cut | 8 | 16.5 |
| Chain saw cut | 1 | 25 |

These cultivars were initially selected by the Natural Resources Conservation Service for outstanding performance as streambank stabilization plants (Lorenz, Sharp, and Ruffner).[3] They are easy to clone and produce roots readily when cuttings are planted in moist soils. Ruby dogwood tends to layer profusely whenever the branches contact the ground. Thus, there was reason to believe that these three cultivars would be well adapted to biotechnical uses. In field planting trials throughout the northeast, these cultivars have been hardy to USDA Zone 3, or minimum temperatures of -30° to 40° F. (USDA-ARS Miscellaneous Publication No. 814). [4]

The planting sites and dates, materials used, and soil textures are listed in Table 2. Site locations ranged from extreme western New York to northern Maine (Aroostook County). Soil textures varied from clay to gravelly sand. Plantings were made over three years and were done either in the spring (6) or fall (1). All plantings involved the use of wattling as the primary method of placement.

All wattles were prepared at the Big Flats, New York and Quicksand, Kentucky Plant Materials Centers. Preparation time varied widely depending on the age of materials used (Table 3). Materials shown as being one year old were usually whips produced in one growing season from stooling beds that were 15-20 years old. The eight year old material was the top growth out of stooling beds which had not been harvested for at least eight years. This older growth was used to simulate native stands.

Cutting methods were varied to simulate harvesting from "native" stands of willows and from nursery stooling beds. "Hand cut" means that the whips were snipped one at a time with hand clippers. "Chain saw cut" with the eight year old material was prepared by cutting down the older stems, then piling them and cutting the tops out. One year old whips were also cut with a chain saw by shearing them off at the base, then gathering them up. ( A tractor mounted cutter bar could have accomplished this task much faster, but that technique was not used.) The approximate production rates were computed from total job times rather than recorded as the methods were used.

Fall planted wattles were transported to the job site and planted within one week. Spring planted wattles were held in cold, wet storage for several weeks until transported and planted.

The only difference noted at planting (between the wattles made from one year old whips and wattles made from older material) was that the "older" wattles were bulkier, requiring more transportation space and larger trenches to plant.

## PLANT GROWTH

Growth response at the seven planting sites is outlined in Table 4. It should be noted that 1988 was a very dry summer compared to 1987 and 1989. Willow growth at all sites has been good both in height and numbers of stems. The best growth was achieved by “Streamco” willow at Gaysville, Vermont, with 48 inches in the first year. It may well be coincidence which was fall planted. More fall planting will be made to see if there is a consistent benefit.

The height growth advantage which “Streamco” had over “Bankers” was expected. “Streamco” has a mature height which is at least twice that of “Banker”, and expresses the advantage with more rapid growth in the nursery.

The failure of “Ruby” dogwood to establish plants in western New York may have been due to the interaction of a small sample size with mouse damage. The site at Gowanda had a pre-existing fescue sod and thriving mouse population. The mice tunneled along the wattles and ate the bark wherever they could gain access. Additional plantings are scheduled to further evaluate the potential of “Ruby” dogwood.

## DISCUSSION AND CONCLUSIONS

“Streamco” and “Bankers” willows have established successfully at all sites where they were used. They have initiated strong root and top growth in a wide range of soil and site conditions including sandy, droughty locations that are not preferred by willows.

**Table 4. Growth of Willows and Dogwood from Wattles**

| Site | Planting Date | Evaluation Date | Average Height (IN) Streamco | Bankers | Ruby | Average Number of Stems Per Foot of Row Streamco | Bankers | Ruby |
|---|---|---|---|---|---|---|---|---|
| Cornwallville NY | 6/87 | 7/31/89 | 36 | - | - | 5 | - | - |
| Gowanda, NY | 5/88 | 10/88 | 11 | 9 | 0 | - | - | 0 |
| | | 10/89/89 | 54 | 24 | 0 | 6 | 10 | 0 |
| Gaysville, NY | 11/88 | 11/1/89 | 48 | - | - | 10 | 1 | - |
| Raymond, NH | 3/89 | 9/12/89 | 20 | 11 | - | 8 | 9 | - |
| Bangor, ME | 5/89 | 9/20/89 | 23 | - | - | 15 | - | - |
| Newcastle, ME | 5/89 | 9/18/89 | 18 | 12 | - | 7 | 5 | - |
| Houlton, ME | 5/89 | 9/19/89 | 18 | 10 | - | 8 | 11 | - |

Preparation of “Streamco” wattles appeared to be more efficient when whips were cut from managed stooling beds as opposed to a simulated native stand. Had the native stand been located under actual field conditions, the differences would likely have been greater.

Fall planted “Streamco” willow wattles were successful in central Vermont on a dry sand road bank. Spring growth was rapid and total growth exceeded that found on similar spring planted sites.

The density of willow stems produced by “Streamco” and “Bankers” wattles was sufficient to alternate downslope sloughing of loose bank materials at all sites.

Nursery grown plant materials have been used successfully on seven sites in New York, Vermont, New Hampshire, and Maine. The interest in biotechnical slope protection is strong enough to warrant further evaluation of production techniques with existing willow and dogwood cultivars. Commercial and state nurseries are encouraged to keep abreast of the developing interest and to anticipate future needs for plant materials.

REFERENCES:


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